Microprocessor regulator type MPR-M

Installation and operating instructions for plant engineering companies

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Function

The MPR-M is a microprocessor-regulated milk-cooling thermostat with automatic afterstirring. It has separate relay contacts for the compressor contactor and the stirrer. The measured milk temperature is shown constantly on the display.

Two freely adjustable target temperatures may be selected by push buttons. Should the milk temperature exceed the chosen target temperature (T1 or T2) by the hysteresis value, the compressor and stirrer are automatically switched on. Once the target temperature is reached, the compressor contactor switches off. The stirrer continues for the programmed period. During refrigeration pauses, the stirrer automatically switches on again according to the programmed intervals, to ensure an even temperature throughout the milk.

Independently of this, a short or longer period of intermittent stirring can be set. If required, a MPR-M model is also available with constant stirring, where the stirrer is turned on or off by push button.

Operation of the buttons for "intermittent stirring[a] and "select target temperature[a] may also be transferred to external switches. Separate connections for this purpose are located on the terminal block (see connection diagram).

Intended use

These operating instructions contain important technical and safety information.

Please read carefully before installation and before any work on or with the regulator.

The electronic milk-cooling thermostat type MPR-M is used to control the stirrer motors and cooling compressors of milk-cooling systems. Any other use of the device is permissible only with the manufacturer's written consent.

The device is fitted with a resistance temperature sensor. The output ports are designed as relay ports.

CE The electronic milk-cooling thermostat type MPR-M fulfils EC requirements for electromagnetic compatibility (EMC). The safety components meet VDE regulations.

Safety

The milk-cooling thermostat may only be installed by an authorised specialist, observing all local safety requirements.

Only specialists must be allowed to access the environment when connected.

The thermostat contains live components and must not be opened.

The device must not be used if the housing or the connection terminals are damaged.

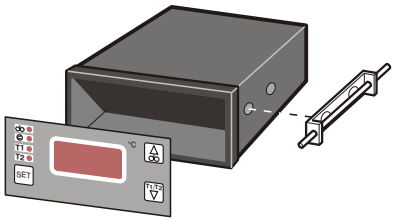
No liquids must penetrate the housing.

The thermostat may be exported to the USA with the permission of the manufacturer only!

Installation

a. It is essential not to install the device under the following conditions:

- severe jolting or vibration
- permanent contact with water
- relative humidity of more than 90%
- sharply fluctuating temperatures (condensation)
- operation in an aggressive atmosphere (ammonia or sulphur fumes) - risk of oxidation
- operation in the immediate vicinity of radio transmitters with high levels of spurious radiation.



b. Housing installation

The housing is secured by means of two screw attachments on the sides.

- Make the appropriate front panel cut-out for the housing
- Push the housing through the front panel cut-out.
- Position the screw attachments.
- Tighten the screws.

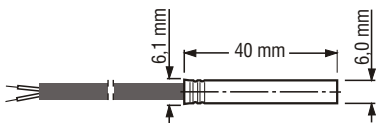
c. Fitting the sensor

The regulator is pre-adjusted to your choice of sensor in the factory. When replacing a faulty sensor, always use the same type.

The sensor cable must not be chafed or kinked.

There must be no strong mechanical pressure on the sensor tube.

Do not place the sensor and the high-voltage cable in the same cable conduit (not even within the switchbox).



Changing the sensor cable length

If it is necessary to shorten or lengthen the sensor cable on installation (or if a sensor other than the one supplied is to be fitted), the "actual value correction" parameter must be adjusted accordingly. See the section "Setting the actual value correction" on page 16.

Observe the permitted temperature range to which the sensor is suited:

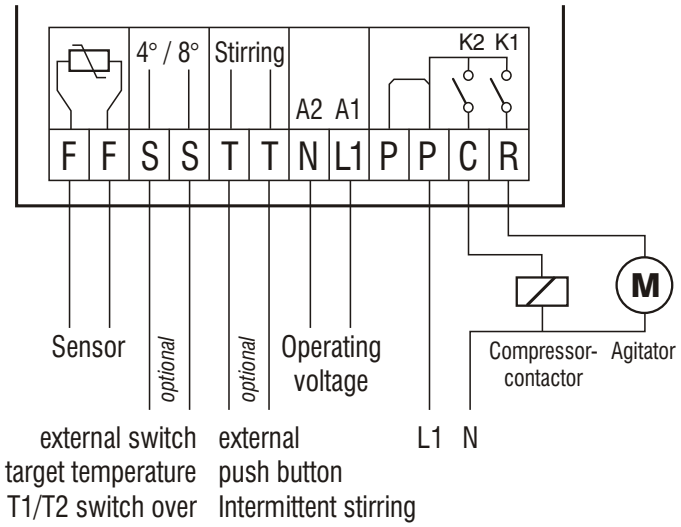
Sensor cable	*temperature range °C*
PVC (standard)	-30° to + 70 °
Silicon	-50° to +180°

d. Electrical Connection

Before connecting, ensure that the mains voltage is the same as indicated on the device's type plate.

A switching contactor for connection of the cooling compressor is essential.

Notice technical Data.



As soon as power is connected to the thermostat, the stirrer will run (for the duration of the programmed afterstirring time C10). The cooling compressor switches on as a function of the milk temperature.

- Carry out the electrical connection process as follows:
- Use cable bushes.
- Make sure that cables cannot chafe.

e. Connection to external operating controls

Operation of the buttons "Intermediate stirring" and "Change target temperature" can be transferred to external switches. The terminal strip has separate connections for this purpose (see connection diagram).

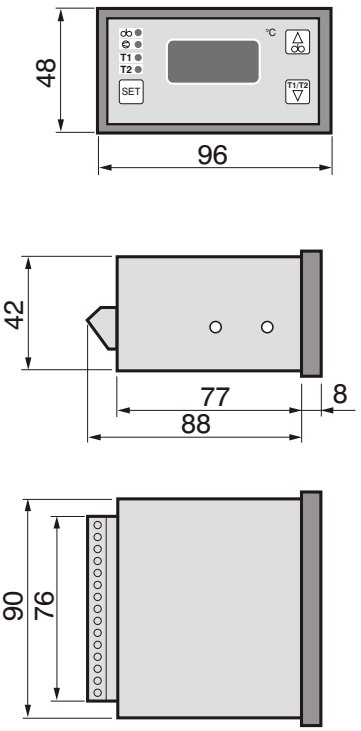
The operating controls needed in such cases are a button for the "Intermediate stirring" function and a selection switch for the function "Change target temperature".

If an external button or selection switch is connected, parameter [P80] or [P81] must be set as appropriate at configuration level.

Caution: do not connect external voltage to the "S/S" or "T/T" terminals.

Buttons or selection switches used must be designed as potential-free make contacts.

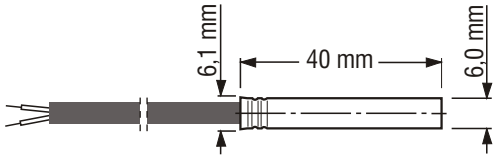
Housing dimensions and technical data thermostat



Operating voltage	230 V AC, 50/60 Hz
Relay contact	2 make-contacts
max. switching current	16A AC 1
max. switching voltage	250 V ~
Display	13 mm LED - Display, 3 digits
Display range - Range -9,9 .. 99,9° C - other	 0,1° C 1,0° C
Control action	two-step-controller
Measurement range	look at techn. data "Sensor"
Hysteresis	0.1 to 99.9 K free adjustable Standard adjusting 0,7 K
Control mode	cooling
Housing - front panel cut out - insertion depht	Norm panel housing - 90 x 42 mm - 88 mm
Protection (housing front)	IP 64
Connection	Screw terminals
Environment specifications: - storage temperatur - operation temperatur - max. humidity	 -20 to 70° C 0 to 50° C 75 % (no dew)

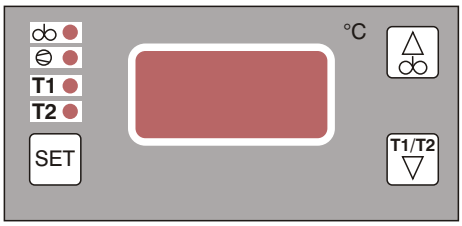
Technical facts with reservation.

Sensor dimensions and technical data



Sensor element	PTC sensor, KTY 81-210
Bush material	1.4301(V2A)
Bush length	40 mm
Bush diameter	6.0 mm +/- 0.1
Cable material	- PVC (standard) - Silicon (special model)
Measurement range KTY 81-210 - Cable PVC - Cable Silikon	 -30 .. 70° C -50 .. 150° C
Cable lenght	standard 2 metres
Protection type	IP 65

Operation



Working level

for everyday operation

Programming level

for setting the regulatory parameters

Configuration level

for setting the basic functions

The regulator is operated at three levels:

Working level

... for everyday operation by the end user.

The present milk-temperature as measured is permanently displayed.

Further funktions of working level:

- Switching over the target temperature T1 / T2
- Display and changing of the target temperature T1 / T2.NB: The target temperature can be adjusted here only if the programming level button lock [C99] is set to "0".
- Intermittent stirring, operated by push button as programmed.

Programming level

This is the level at which the regulatory parameters are set.

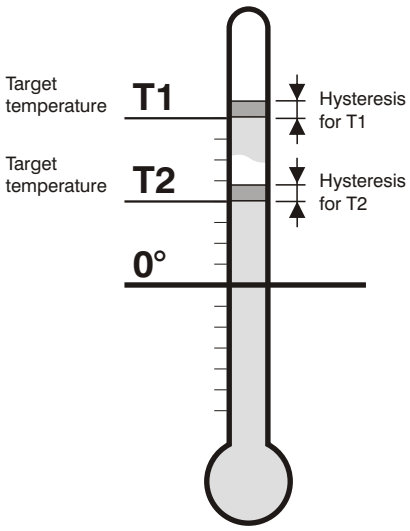
Setting is more complex and possible only using specific combinations of buttons so as to prevent accidental changes to settings.

Configuration level

This is the level at which the basic functions of the regulator are set.

As subsequent interventions by the end user (after the parameters have been set) can result in dangerous changes to functions which might not be immediately obvious, access to the configuration level is even more complex.

Operation overview



- The milk is cooled to the selected target temperature (T1 or T2). The stirrer runs constantly at this stage.
- Once the target temperature has been reached the compressor switches off.
- The stirrer switches off after the programmed afterstirring time.
- During refrigeration pauses, the stirrer switches on for the duration of the afterstirring time to ensure an even temperature throughout the milk.
- Should the milk temperature exceed the selected target temperature (T1 or T2) by the hysteresis value, the compressor and stirrer are automatically switched on again.

Parameter settings in general

To adjust a parameter, proceed as follows:

- Select parameter.
- Hold the SET button down during the adjustment operation.
- Use the up-arrow or down-arrow to set the required value. NB: Holding the arrow down longer changes the value more quickly.
- Release the SET button.

To store the changed parameter in the memory, first release the arrow, and then the SET button.

Switching back to working level:

(possible from any parameter)

- Press up-arrow and down-arrow simultaneously for approx. 5 seconds. The current actual value appears in the display.

If, at programming or configuration level, no buttons are pressed for approx. 1 minute, the regulator switches back to working level automatically.

Working level operation

The working level is for day-to-day milk cooling operation. When the regulator is switched on, the display continuously shows the current milk temperature.

Operating overview for working level

15.8 *present ACTUAL VALUE (displayed continuously)*

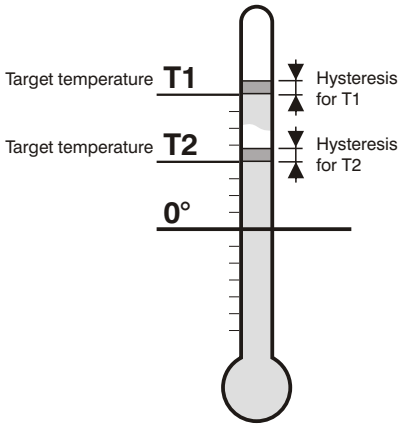
Switch from target temperature T1 to T2	T1/T2	T1 ● / T2 ● *The LED changes from T1 to T2 or from T2 to T1*
SHORT interm. stirring *until **Sho** appears*	1 sec.	*Duration corresponds to programmed value C50*
LONG interm. stirring *until **Lon** appears*	3 sec.	*Duration corresponds to programmed value C51*

	Display setting	*Altering setting*	*Factory setting*
	Press SET button	*Press SET and △ or simultaneously ▽*	
Target temperature T1 *when LED T1 ● lit*	SET	⊕ △ or ▽	8°
Target temperature T2 *when LED T2 ● lit*	SET	⊕ △ or ▽	4°

Changing the target temperature is possible only when the button lock in the programming level [C99] is set to "0".

No	Function
1	LED - "Agitator" shows if agitator is switched on
2	LED - "Compressor" shows if compressor relay is switched on
3	LED - "T1" shows that target temperature "T1" is active
4	LED - "T2" shows that target temperature "T2" is active
5	Press button "SET" = Target temperature T1 or T2 displayed Adjust target temperature T1 or T2 upwards or downwards by simultaneously pressing button 6 or 7.
6	Button "Arrow UP"/"Agitator" -press for appr. 1 sec = "SHORT" intermediate stirring -press for appr. 3 sec = "LONG" intermediate stirring See also the section describing the intermediate stirring options page 12. Press button together with button SET = -adjust the current target temperature upwards
7	Button "Arrow DOWN"/"T1/T2" Switch target temperature from T1 to T2, or from T2 to T1 Press button together with button SET = -adjust the current target temperature downwards

Programming level operation



Operating overview for programming level

To change to programming level =
△+▽ *Press for 5 seconds simultaneously, until parameter C1 lit.*

		Display setting	*Altering setting*	*Factory setting*
		Press SET button	*Press SET and △ or simultaneously ▽*	
Target temperat. for T1	C1	SET	⊕ △ or ▽	8°
	△			
Target temperat. for T2	C2	SET	⊕ △ or ▽	4°
	△			
Hysteresis for target temp. 1	C10	SET	⊕ △ or ▽	0,7 K
	△			
Hysteresis for target temp. 2	C11	SET	⊕ △ or ▽	0,7 K
	△			
Duration of afterstirring	C20	SET	⊕ △ or ▽	120 sec.
	△			
Duration of pause	C21	SET	⊕ △ or ▽	20 mins.
	△			
Duration of "short" intermittent stirring	C50	SET	⊕ △ or ▽	2 mins.
	△			
Duration of "long" intermittent stirring	C51	SET	⊕ △ or ▽	10 mins.
	△			
Sensor correction	C91	SET	⊕ △ or ▽	
	△			
Button lock	C99	SET	⊕ △ or ▽	0

To switch back to the working level:
△+▽ *Press for 5 seconds simultaneously*
(Switches back automatically after 30 seconds.)

The programming level is for setting the regulatory parameters. Access to this level is more complex in order to avoid accidental resetting of the values by the end user.

Switching to programming level:

- Press up-arrow and down-arrow simultaneously for approx. 5 seconds.The first parameter [C1] appears in the display.
- Press up-arrow or down-arrow until you reach the parameter you want to adjust.

Meaning of parameters

Parameter C1: Target temperatur for T1

Parameter C2: Target temperatur for T2

The target temperature is the temperature at which the corresponding relay contact is to be activated.

Parameter C10: Hysteresis for target temp. 1

Parameter C11: Hysteresis for target temp. 2

The hysteresis determines how much the milk temperature may deviate from the target temperature before the cooling compressor is switched on.

Parameter C20: Duration of afterstirring

Duration (sec.) for which the stirrer runs after the compressor has switched off.

Parameter C21: Duration of pause

Duration (min.) until the stirrer is switched back on after being turned off.

Parameter C50: Duration of "SHORT intermittent stirring"

Duration (min.) of stirring after short pressing of the "intermittent stirring" button.

Parameter C51: Duration of "LONG intermittent stirring"

Duration (min.) of stirring after longer pressing of the "intermittent stirring" button.

Parameter C91: Sensor correction

The sensor reading can be provided with a corrector which works cumulatively over the entire measurement range.

See also the section on "sensor installation" Page 13.

Parameter C99: Button lock

Alteration of the target temperatures in the working level can be blocked by setting the button lock.

0 = lock off

1 = lock on

Configuration level operation

This level is for configuring the regulator's basic functions.

To prevent interference by the end user, access is made even more complex.

Switching to configuration level:

- Press button "Arrow UP" and "Arrow DOWN" simultaneously for approx. 5 seconds. The first parameter [C1] appears in the display.
- Press button "Arrow UP" repeatedly until the last parameter [C99] at working level is reached.
- Press button "Arrow UP" again and hold down until [Pb] appears in the display.
- When [Pb] appears, hold down button "Arrow UP" and simultaneously press button "Arrow DOWN" for approx. 3 seconds.
- The display then shows the first parameter [P5] in the configuration level.

Operation overview for configuration level

Switching to configuration level: see description

		Display setting	*Altering setting*	*Factory setting*
		Press button SET	*Press button ▽ and △ simultanously*	
Sensor failure function K1	P5	SET	⊕ △ or ▽	1
Sensor failure function K2	P6	SET	⊕ △ or ▽	1
Hysteresis-mode for T1	P10	SET	⊕ △ or ▽	1
Hysteresis-mode for T2	P11	SET	⊕ △ or ▽	1
Limit for target-temp. T1 downw.	P20	SET	⊕ △ or ▽	0
Limit for target-temp. T1 upw.	P21	SET	⊕ △ or ▽	10
Limit for target-temp. T2 downw.	P22	SET	⊕ △ or ▽	0
Limit for target-temp. T2 upw.	P23	SET	⊕ △ or ▽	20
Limit for Hyst. 1 downwards	P30	SET	⊕ △ or ▽	0,1
Limit for Hyst. 1 upwards	P31	SET	⊕ △ or ▽	2
Limit for Hyst. 2 downwards	P32	SET	⊕ △ or ▽	0,1
Limit for Hyst. 2 upwards	P33	SET	⊕ △ or ▽	2
Min. action time Compr. K1	P70	SET	⊕ △ or ▽	0
Min. pause time Compr. K1	P71	SET	⊕ △ or ▽	0
Switching T1 to T2	P80	SET	⊕ △ or ▽	0
Mode intermitt. stirring	P81	SET	⊕ △ or ▽	1
Temperature scale	P99	SET	⊕ △ or ▽	0

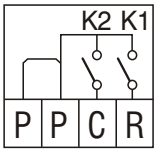
To switch back to the working level:
△+▽ *Press for 5 seconds simultaneously*
(Switches back automatically after 30 seconds.)

Meaning of parameters

Param. P5: Function K1 in event of sensor failure
Param. P6: Function K2 in event of sensor failure

The switching status of the relay contacts can be set for the event of a sensor failure.

0 = OFF in the event of failure
1 = ON in the event of failure

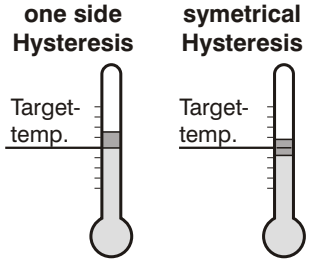


Parameter P10: Hyst. mode for target temperature T1
Parameter P11: Hyst. mode for target temperature T2

(with reference to the compressor relay)

0 = symmetrical
1 = one-sided

The hysteresis determines the value by which the temperature of the medium may deviate from the corresponding target temperature before the relay contact is activated. See diagram.



If the contact in question is for cooling, the hysteresis is always upwards. In the case of heating contacts it is below the target temperature (cooling or heating contact is set at configuration level).

In the "symmetrical" hysteresis mode, the value selected is distributed on both sides of the target temperature.

Parameter P20: Limit for target temp. T1 downwards
Parameter P21: Limit for target temp. T1 upwards
Parameter P22: Limit for target temp. T2 downwards
Parameter P23: Limit for target temp. T2 upwards

Setting of input limits for target temperatures at working and programming levels.

Range: -10 .. 99°C

Parameter P30: Limit for hysteresis T1 downwards
Parameter P31: Limit for hysteresis T1 upwards
Parameter P32: Limit for hysteresis T2 downwards
Parameter P33: Limit for hysteresis T2 upwards

Setting of input limits for hysteresis at programming level.

Range: 0 .. 99 K

Parameter P70: Minimum action time for compressor K2

Setting of minimum action time for compressor relay contacts K2, in order to prevent repeated switching on and off.

Range: 0.0 .. 999 seconds.

Parameter P71: Minimum pause time for compressor K2

Setting of minimum pause time for compressor relay contacts K2, in order to prevent repeated switching on and off.

Range: 0.0 .. 999 seconds.

Parameter P80: Switch from target temperatur T1 to T2

Setting of funktion: "switching target temperature"

0 = not possible(target temperature T1 is active)
1 = with button(standard, activate with button "T1/T2")
2 = with external switch
external switch open: target temperature T1 is active
external switch close: target temperature T2 is active

Parameter P81: Function intermittend stirring

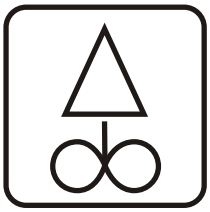
Setting of funktion: "start manual intermittend stirring". See section "Intermediate stirring options during cooling" - page 12.

0 = not possible (intermittend stirring not possible)
1 = with button (standard, activate with button "Agitator")
2 = with external push button
3 = permanent stirring ON / OFF

Parameter P99: temperature scale

To switch the display between degrees Fahrenheit and degrees Celsius.
0 = Celsius
1 = Fahrenheit

Intermediate stirring options during cooling



The microprocessor regulator type MPR-M has a function allowing the agitator to be switched on manually. This can be done is different ways.

Regardless of the option chosen, the corresponding LED always indicates when the agitator is operating.

The function is set at configuration level using parameter [P81].

a. Parameter [P81] is set to 1:

"Intermediate stirring SHORT or LONG" can be switched on via the regulator's foil keyboard. In this case:

- Intermediate stirring SHORT =
  Press agitator button for approx. 1 sec. until "Sho" appears in the display. Release the button immediately, otherwise "Intermediate stirring LONG" will be activated.
- Intermediate stirring LONG =
  Press agitator button for approx. 3 secs. until "Lon" appears in the display.

The duration of SHORT or LONG stirring is fixed at settings level using parameters [C50] and [C51].

b. Parameter [P81] is set to 2:

"Intermediate stirring SHORT or LONG" is switched on via an external switch. The same button functions apply as in the case of option a.

c. Parameter [P81] is set to 3:

On request the MPR-M can be set for "continuous stirring", i.e. the agitator can be switched on and off by pressing a button.

When the agitator is switched on or off, the display briefly indicates "ON" or "OFF".

Setting the actual value correction

A correction can be made to the value as measured by the sensor, which applies cumulatively over the entire measuring range.

This is necessary when:

- the length of the sensor cable is changed, or
- a faulty sensor is replaced, giving rise to an incorrect reading.

In order to adjust the actual value correction, a reference thermometer (e.g. WELBA THM-2000) is needed.

Proceed as follows:

- Install sensor.
- Measure the milk temperature using the reference thermometer.
- Switch on the thermostat and set parameter [C91] in the programming level to "0".
- Switch back to working level and read the measured temperature on the display.
- Calculate the difference between the reference thermometer temperature and the display reading.
- Store the difference (pay attention to plus or minus) in the working level under parameter [C91].

Fault indication on the display

Faults in the regulator are indicated by a flashing display as follows:

LED - Display	*Fault*
F1	**Sensor short circuit:** The sensor or sensor cable is faulty and must be replaced or repaired. Parameter [C91] "Actual value correction" must then be adjusted at programming level.
F2	**Broken sensor:** The sensor or sensor cable is faulty and must be replaced or repaired. Parameter [C91] "Actual value correction" must then be adjusted at programming level.
F3	**Memory fault:** Faulty regulator! Remove the regulator and send it for repair.
FFF	**Measurement range exceeded:** The maximum measurement range of the sensor has been exceeded.

General measures when using electronic control systems

So that even complicated regulatory tasks can be presented to the user in a manner which is clear and simple and ensures high measurement accuracy, today's electronic control systems make increasing use of microprocessors. However, the benefits of these systems are countered by the disadvantage that increased measurement accuracy is accompanied by sensitivity to interference. In order to minimise the effect which interference may have on the regulator, the user also must take account of a number of points when installing a new regulator.

Assistance here is provided by standard DIN VDE 0843 on the electromagnetic compatibility (EMC) of measurement, control and regulatory devices in industrial process technology. The following table shows, for example, the maximum interference levels to which, according to the standard, an appliance may be exposed.

Degree of severity	*Environment class*	*Test voltage Power supply*	*Test voltage Signal/control line*
1	well-protected environment	0.5 kV	0.25 kV
2	protected environment	1.0 kV	0.5 kV
3	typical industrial environment	2.0 kV	1.0 kV
4	Industrial environment with very high interference level	4.0 kV	2.0 kV

As the values given in the table are maximum values, operational values should remain well below them. However, in practice this is possible only with difficulty, as even a normal contactor without interference suppression produces interference pulses of up to 3.0 kV. For this reason we recommend that the following principles be taken into account during installation:

a. Try to eliminate all sources of interference, by carrying out interference suppression and minimising the interference level. Radio interference suppression is required under VDE 0875, and confirmed by VDE 0874. In principle, interference must be eliminated at source. The nearer the interference suppresser is to the source of interference, the greater its effect.

Interference spreads through wires or by electromagnetic radiation. It is usually the former which interferes most seriously with regulation systems.

Possible interference sources (to name but a few) include:

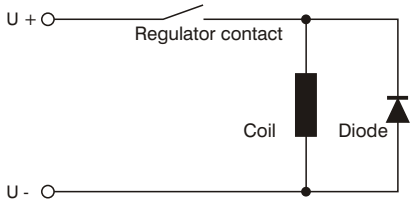
- bouncing contacts when switching loads
- switching off inductive loads (contactors, motors, solenoid valves, etc.)
- unsatisfactory routing of wires, too small cross-sections
- loose contacts
- rhythmically changing power stages (power converters)
- power breakers
- high-frequency generators

b. If specific interference sources cannot be avoided, they should at least be kept at a distance from the regulator system.

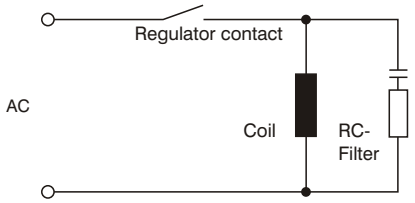
c. Capacitive and inductive couplings can cause crosstalk between high-voltage lines and parallel low-voltage and sensor lines. This distorts measured values and signals and can disrupt the entire regulatory process. It is therefore recommended that all sensors and signal lines be placed separately from the control and mains voltage lines.

d. If possible, a separate mains line should be provided to feed the regulator system. This helps reduce any interference penetrating the regulator via the mains supply line. Voltage surges resulting from switching substantial loads will also then be less of a problem.

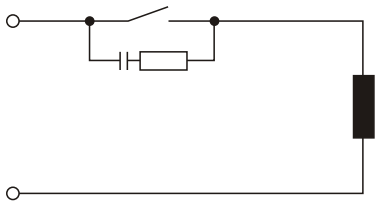
e. In the case of contactors, solenoid valves and other inductive consumers, the induction voltage occurring during switching has to be reduced by appropriate protection methods. The choice of methods depends on whether the consumer runs on DC or AC voltage.



- *DC voltage*
  In the case of d/c voltage systems, the induction voltage occurring can, for example, be limited by using self-induction diodes, varistors or suppresser diodes. The diagram on the left shows one possibility using a self-induction diode.



- *AC voltage*
  In the case of a/c voltage, interference suppression as described above is not possible. Instead, an RC combination must be used. An RC filter must be connected as directly as possible to the inductance, in order to ensure a short line. In addition, the component ratings of the RC combination must be geared to the inductance. Too low ratings lead to excessive voltage, and too high ratings cause significant losses in the interference suppresser component. Another point to note here is that only capacitors which meet VDE 0656 may be used. They must be suited to the mains voltage and designed for very high switching voltages. The diagram on the left shows inductance interference suppression using an RC filter.



An RC filter should not be fitted directly to the regulator's switching contact, as shown on the left, as an idle current will flow through the RC combination even when the switching contact is open. This current may be enough to mean that a downstream contactor is not de-energised and a closed protective contact does not reopen.

f. Semiconductor switches such as thyristors or triacs also produce interference voltages. They occur as a result of non-linear characteristics and finite ignition voltages. These components must be protected against excessive voltages, for which mainly varistors, RC combinations or choke coils are used. The use of zero-voltage switches is also recommended.

The suggestions made represent only a few of the possible ways of protecting a microprocessor-controlled regulator system from interference. The suggested measures have the advantage that they will increase the lifetime of the devices, as lower induction voltages (reduced spark formation) will also reduce contact burn.